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ARS SPECIAL REPORT

Plant Pest Detection

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Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE

SUMMARY

Insects and plant diseases because of their depredations and because of money spent to control or eradicate them cost the people of the United States more than $7 billion a year. Early detection and prompt reporting of new pests or infestations, before they become established and spread over large areas, are the surest known ways to keep this cost from going higher. A "new" pest is usually a recent arrival that escaped the vigilance of our border defenses, or one that arrived by natural spread from a neighboring country.

This report discusses some of the aspects of plant pest control and shows how agricultural leaders generally can contribute to a dynamic detection program: (1) By being constantly alert to notice and report any unusual insect or pest activity and (2) by encouraging farmers, foresters, livestock growers, outdoorsmen, Boy and Girl Scouts, 4-H'ers, vocational agricultural students, and others to do likewise. Some things to watch for are:

- Unusual plant injury or failure in home plantings, crops, or forests.
- Any unfamiliar type of destructive pest.
- Sudden appearance of large numbers of damaging pests in crops, forests, parks, or in stored products.
- Evidence of unusual pest attacks on people, pets, or livestock.

Information in this report was provided by the Plant Pest Control Division, Agricultural Research Service

PLANT PEST DETECTION

Agricultural leaders generally are urged "to keep their eyes open" as they go about their daily tasks and to report any suspicious plant pest or infestation they may encounter. They are further urged to act as aids to plant pest control officials and farmers, ranchers, orchardists, or others who consult them about possible new pests or infestations. A single new pest or infestation discovered in time can easily prevent losses of millions of dollars. On the other hand, a destructive pest that initially eludes detection and becomes established may become a menace forever, and may significantly add to the $7 billion that plant pests cost us each year.

This appeal for more volunteer "detectors" is part of an intensified Federal-State effort to detect successful invaders before they become established or the spread of pests now in this country but presumably confined to relatively small areas. The seriousness of this work cannot be overemphasized. A single individual of a species like the white-fringed beetle that finds its way out of domestic quarantine or is reintroduced from other countries could conceivably start devastating infestations--because the white-fringed beetle reproduces without mating.

Many people who work with crops, animals, stored grain or grain products are in a position to watch for suspicious circumstances that may indicate the presence of a new pest. Specimens collected, however, have to be studied by taxonomists--highly trained specialists who are the only ones qualified to identify a pest as a new invader. Volunteer detectors should therefore be extremely discriminating--to avoid burying the comparatively few taxonomists under a flood of common insects. As middlemen, agricultural leaders should consider each local submission carefully and check the circumstances under which the discovery was made before passing it along for official identification.

Most of our problem pests today are invaders. The Plant Quarantine Division[1] of the Agricultural Research Service, U. S. Department of Agriculture, is officially charged with the responsibility of keeping invading pests out of the country. Its inspectors intercept thousands but some understandably slip through. Many of the initially successful invaders undoubtedly encounter adverse environments and consequently perish almost immediately. The ones that find their way into favorable environments, however, may establish themselves quickly, thrive, and reproduce prodigiously because their natural enemies seldom immigrate with them.

The Plant Pest Control Division, ARS, USDA, is officially charged with the responsibility of preventing spread and for controlling and eradicating important invading pests within the States. Survey and Detection Operations of the Division is the coordinating force behind the intensified detection program, which is voluntarily manned in all 50 States by entomologists, inspectors, researchers, Extension Service specialists, county agricultural agents, and hundreds of private individuals. These agents send

[1]More information about this division, its work, and how the public can cooperate to make its work more effective appear in ARS 22-54, "Enlisting Public Cooperation in Keeping out Foreign Animal and Plant Pests," available from the Agricultural Research Service, U. S. Department of Agriculture, Washington 25, D. C.

reports about pests in their areas to a State clearing officer who evaluates them, makes use of the information, and forwards weekly pest summaries to the Plant Pest Control Division. The program is further strengthened in about 30 States through the work of cooperatively financed survey specialists. The Division edits the summaries and publishes them in the "Cooperative Economic Insect Report," which eventually reaches about 3,000 persons in Federal and State agricultural agencies, in industries, and in various other agricultural occupations. This weekly publication has been of great help in planning and carrying out pest control activities. Its utility can be enhanced by additional reportings from more participants who understand and appreciate the plant pest problem and who are alert to detect new pests or infestations.

MORE ABOUT EARLY DETECTION

One morning in 1956, Mr. O. L. Prior, Miami Shores, Fla., stepped into his backyard and picked a grapefruit. Inside the fruit he saw maggots or "worms" busily feeding. Mr. Prior might have discarded this particular grapefruit and picked another, but he didn't. He reported his discovery to the Dade County agricultural agent, Mr. Douglas Knapp. Mr. Knapp might have casually dismissed the incident as trivial, but he didn't. He got in touch with plant pest control officials. The maggots proved to be larvae of the Mediterranean fruitfly, a destructive foreign pest of fruit and vegetables. The subsequent eradication program took a year and a half and cost $10 million but the resulting savings to fruit and vegetable growers are enormous. A conservative estimate of the value of fruit and vegetables thus protected is $400 million a year, for Florida alone. Even moderate damage plus cost of treatments could easily amount to over $50 million annually in that State.

The eradication campaign was successful because the infestation was detected before it became firmly established over the entire area. It might not have been successful if Mr. Prior or Mr. Knapp had not taken the trouble to resolve a suspicious circumstance. Their timely observation and prompt reporting are examples of what is needed to make the intensified detection program a success.

A converse example is the European corn borer. This pest probably began its career in the United States as a few pinkish-brown "worms" on imported broomcorn in Massachusetts about 1910. Its discovery did not come until 1917--too late for successful eradication. By 1949, its depredations reached an alltime high of $350 million. The borer now feeds in cornfields in 39 States. Although the borer's introduction into the United States preceded the setting up of the important Plant Quarantine Act of 1912, the rapidity with which it spread and its consummate destructiveness are frightening examples of what unchecked pests can do.

Another example is the spotted alfalfa aphid. This pest was first identified in the Southwest in 1954. It spread into 30 States in 3 years. In 1956, it cost forage growers $42 million. Some evidence exists that it was actually in the United States in 1953 or earlier, but its presence was apparently overlooked because it resembled another species. Had it been reported in 1953, however, instead of 1954, plant resistance studies and research on control could have begun a year earlier and might have resulted in significant savings to American agriculture.

There are many other pests in the United States presently confined to certain areas that have caused heavy losses of food and fiber. All are invaders. Other potential invaders exist in nearly every foreign country.

SOME CONFINED INVADERS

In the United States, 85,000 or so of known pests are feeding and multiplying. Of these, several hundred are destructive enough to be of major importance. Within the several hundred are veritable "stars"--pests justly respected for their destructiveness, their potential destructiveness, and for the insidious manner in which they spread. Some of the "stars" are discussed below:

The gypsy moth, a real "old timer," has been in this country since 1869. In caterpillar state, it devours foliage, thus weakening or killing trees; the damage it has done runs into millions of dollars. Strenuous eradication, quarantine, and control measures have so far confined it to the Northeastern States and to one small outlying infestation in Michigan. This pest could spread South and West and menace trees east of the Great Plains.

The Japanese beetle, as a grub and as an adult, feeds on more than 275 kinds of plants. Infestations in the Eastern States and some of the Southern States cost farmers, nurserymen, and others more than $10 million a year. So far this pest has been kept east of the Mississippi. Its potential for spread is great, however, as attested by the fact that it began its depredations in this country in a New Jersey nursery in 1916.

The pink bollworm, a native of India, got into this country through Mexico, presumably in 1917. So far this insect is confined to 6 of the 17 cotton-producing States. It is extremely persistent. When eradicated in one area, it breaks out in another. In 1952, its most destructive year in this country, it cost cotton growers more than $28 million.

The golden nematode, a major agricultural pest in Europe and parts of South America, can cut potato yields as much as 85 percent. It was first found in the United States in 1941 on Long Island, N. Y. Strict Federal-State quarantine and control measures have so far confined it to a small area of that island. Potential for spread--into any area where potatoes are grown, which is all of the States and about 1.5 million acres.

The khapra beetle, a native of India, feeds on stored grain and other stored products; it was first found in the United States in California in 1953, later in Arizona and New Mexico and in 1959, in West Texas. Cooperative programs to prevent spread and control it have been so successful that there is no known infestation remaining in the U. S. It is extremely difficult to control because it is small and hides adroitly in grain, the ears of grain sacks, walls of storage buildings and similar places. Eradication measures have so far cost more than $7 million. Potential for spread is unlimited.

Witchweed, a native of Africa and Asia, is a parasite of corn and some other plants of the grass family. It was first found in the western hemisphere in North and South Carolina in 1956. It is confined at this time to 22 counties in these States. Its potential for spread is enormous inasmuch as one plant produces thousands of seed and the seed can lie ungerminated, but viable, for as long as 10 years. If it became established in the Corn Belt or the sugarcane States, $5 billion worth of crops would be in jeopardy. Aggressive Federal-State measures for its control and prevention of spread are underway.

SOME POTENTIAL INVADERS[2]

The listings below are obviously not complete. They may not even be the most destructive of potential invaders. If they gained entry into the United States, however, chances are they would be economically destructive.

Two general feeders, found in Europe, Asia, and Africa, are the silver "y" moth (the silver "y" is on the forewing) *(Autographa gamma)* and the turnip moth *(Agrotis segetum)*. The first damages potatoes, beets, flax, hemp, crucifers, and legumes. When a crop is destroyed, the larvae often migrate in large numbers to other fields. The second feeds voraciously on young nursery stock, grain, vegetables, cotton, tobacco, and grapes. Its devastations in Russia in past years has led to widespread famine.

Five species of potato weevil occur in Bolivia, Peru, Colombia, Ecuador, and Mexico. All have similar habits. The larvae bore through tubers without showing external evidence of infestations; the adults feed on foliage. All have been intercepted at our borders at one time or another. Some may be parthenogenic--therefore, even one escapee would be dangerous.

Senn pest *(Eurygaster integriceps)* and durra stalk borer *(Sesamia cretica)* are important foreign pests of grain and forage crops. The first attacks stems and kernels of small grain causing losses seldom less than 25 percent. It has caused more damage in Iraq than grasshoppers; led to famines in Iran; and caused extensive destruction in Russia and Turkey. The second attacks corn, broomcorn, and sorghum. In some parts of the Mediterranean area it destroys more corn than the European corn borer. It has been intercepted frequently in shipments of broomcorn from Italy.

The European cherry fruitfly *(Rhagoletis cerasi)* causes severe damage in central Europe; infestations in Norway are often over 90 percent. This pest has been frequently intercepted--31 times during one season at Atlantic seaports.

An apple sucker *(Psylla mali)* is another foreign pest dangerously close to home. It has caused considerable damage in orchards in Nova Scotia and New Brunswick, Canada, and in England.

But knowing that a destructive pest exists in some other country and that it may find its way through domestic quarantine or past our border guards is not enough. Along with this awareness must go alertness--being watchful for signs that may betray a new pest's presence. The success of the intensified detection program depends on the alertness and awareness of its participants and on detections being made without formal searches.

DETECTING WITHOUT SEARCHING

Specific, organized searches to find pests in an area where they have not been previously known have been carried out from time to time in the United States. The most extensive, conducted during 1943 to 1945 as part of wartime defense measures, turned up 41 insects and 17 plant pathogens not previously recorded in the United States. To establish these as newcomers, over 31,000 lots of insects and other pests were submitted to

[2] Comprehensive listings appear in "Insects Not Known to Occur in the United States," published yearly by the Plant Pest Control Division and available from the Agricultural Research Service, United States Department of Agriculture, Washington 25, D. C.

Federal taxonomists after being screened at local levels. Fortunately none of the new specimens proved to be of particular economic importance.

Although searches of this type are very valuable, they are too expensive for general application. The Mediterranean fruitfly discovery, however, proves that many people, not specifically engaged in plant pest control work, but informed and alert and in a position to notice changes in familiar surroundings, can detect and report pests of tremendous economic importance.

Other discoveries bear out these statements. Even though formal and fairly comprehensive surveys are conducted annually for the Japanese beetle in the nonregulated areas, two of the most important finds in the last 10 years were reported by people outside of plant pest control work--one by a grain elevator operator in Sheldon, Ill., in 1953, and the other by homeowners and a county agricultural agent at Pikeville, Ky., in 1958. Both infestations are proving difficult to control because of the vast area they embodied when they were discovered.

An exchange student from India was luckily present one day in a North Carolina plant disease clinic. There he saw the pest witchweed and recognized it for what it is. Because of his timely observation, plant pest control officials were able to attack an invader before it spread and became established in our main corn-producing area. Losses thus prevented are difficult to estimate because witchweed could conceivably be as destructive as the European corn borer.

OTHER ASPECTS OF PLANT PEST DETECTION

Potentially destructive pests may be noticed, but not recognized for what they are. The spotted alfalfa aphid was originally thought to be a pea aphid and the khapra beetle was originally mistaken for a domestic carpet beetle.

In 1959, a retired chemical engineer whose hobby is entomology reported that he had found a pumpkin caterpillar in Florida. This particular pest is economically important in the Old World and U. S. plant pest officials knew something about it. They tended to discount the discoverer's claim. When specimens were submitted, however, the claim was verified. This incident prompted many reexaminations of existing collections. Florida's collection contained specimens collected as early as 1946. Some undetermined specimens from the U. S. National Museum also proved to be the pumpkin caterpillar. These had come from six locations in South America and the West Indies, the earliest record being 1903. The pumpkin caterpillar had presumably been in the Western Hemisphere for nearly 60 years without being identified.

These incidents point up how infinite and varied the problems of plant pest detection and plant pest identification are. Nearly 850,000 different kinds of insects have been described and named. It is estimated that twice that number remain to be identified. Some of the knowns and unknowns will undoubtedly become pests of economic importance in the countries they invade and may exist there unrecognized until their destructiveness becomes too apparent to go unnoticed.

It is seldom possible to estimate a pest's potential destructiveness outside of its native land. All discoveries, therefore, merit healthy respect and suspicion. Again, alertness and awareness are the watchwords and make early detection a practical possibility.

STITCHES IN TIME?

Results so far from the intensified detection program are encouraging. Ten pests new to the United States were reported in 1959. This is almost 3 times as many as were reported in 1958 or any recent year.

Five new records, which include the pumpkin caterpillar, came from Florida. Among the other four were a Cuban May beetle, reported to the survey entomologist from the Miami area by a park superintendent. This pest defoliates several kinds of trees and its grubs apparently feed on plant roots. Also reported were a new ant (noneconomic as yet); a wood boring pest, which is a tropical species; and a rice root aphid, an Asian species. The last reporting came from a Plant Pest Control Division inspector who was looking for the vector of hoja blanca disease of rice when he discovered the aphid. It illustrates points often repeated--important detections can be made during the course of regular work, and an open mind often notices the unlooked for.

Other new records made in 1959 are the following:

From Long Island, N. Y., an editor of the Audobon Society turned in an European katydid (noneconomic as yet). The discoverer of the pumpkin caterpillar also reported a new stored-grain pest, which is a European species, in Massachusetts. A research entomologist in California found a new thrips that later on in the year was observed damaging lettuce in New Mexico. It is a Near Eastern-African species. A new Douglas-fir moth was reported from Montana by the Forest Service, USDA.

A Plant Quarantine Division inspector discovered an important European pine shoot moth infestation in 1959 in the State of Washington, the first time this pest had been found on the west coast.

THINGS TO THINK ABOUT

If present trends are true indicators, the United States can expect more pest invasions, not fewer. For some time, entomologists have noted a persistent movement of insects and other pests from older areas of civilization into the newer areas. Five of six thousand different kinds of foreign pests probably exist in the United States today. Yet Europe has very few American pests. Notable exceptions are the Colorado potato beetle and the fall webworm. Hawaii has imported practically all of its injurious pests; so has New Zealand, Australia, and South Africa.

The speed, complexity, and magnitude of worldwide travel and commerce materially aid the eager immigrants to the New World. Planes from Europe, Egypt, Asia, or any foreign country may fly nonstop directly to Chicago or any inland city of the United States. Almost as soon as the St. Lawrence Seaway opened, plant quarantine inspectors found khapra beetles abroad a freighter putting in a Cleveland, Ohio.

The destruction that plant pests can accomplish merits more discussion. In addition to significant losses in dollars and cents in any given year, they can completely dominate an area and make the growing of a certain crop in that area impossible. When the pink bollworm reached Hawaii in 1909, for example, cotton growing had to be abandoned. Within a short time after the oriental fruitfly became established in Hawaii, it caused complete loss of fruit crops except pineapple. In the United States, chestnut blight, a fungus disease imported from Asia, has killed all the native

chestnut trees from Canada to the Gulf States. No other plant pest depredation has ever approached this record. The fungus was first noticed in New York City in 1904.

The beetle that thrives on cayenne pepper, the fly that survives in hot springs and alkaline water, the grub that can live in oil and sends up a periscope-like appendage to keep in touch with the outside world, or the beetle that feeds on the cork stoppers of cyanide bottles may be only curiosities. But other unidentified, consummately destructive pests may have similar bizarre characteristics that will enable them to resist all available eradication measures that may be taken against them.

SUCCESSES AND EXPECTATIONS

Entomologists and other scientists in the United States have eradicated the Mediterranean fruitfly twice, the citrus blackfly twice, Hall scale, date scale, citrus canker, and the white garden snail twice. These 9 victories over 5,000 or 6,000 enemies may appear to be extremely modest. Actually, they are significant and encouraging because they indicate that mankind is no longer completely at the mercy of plant pests. We no longer have to stand by helplessly, or hope for a fortuituous accident, while pests help themselves to our crops, stored grain and grain products, livestock, trees and shrubbery. The Biblical lament (Joel 2: 3) "yea, and nothing shall escape them" is no longer universally applicable.

In other words, we have the weapons and strategy to eradicate or effectively control most invading or spreading pests if they can be detected before they become entrenched. Expectations are good that this desirable objective may be closer to universal realization because of recent developments and discoveries:

Fewer important economic pests are successfully invading. Of the 100 most-feared pests introduced since 1900, only 15 got in during the 20 years preceding 1958--seven times that many during the other years. This remarkable record is attributed to increased vigilance at our ports of entry.

Scientists of the Agricultural Research Service are developing more effective lures. The oil of angelica seed lure used successfully against the Mediterranean fruitfly in Florida proved the efficacy of this approach. Two new ones show great promise. The first one, called "gyplure," is chemically related to a natural attractant recently isolated from the female gypsy moth. It can be made cheaply, and will materially aid in locating infestations of the gypsy moth, in determining the need for control measures, and in assessing the effectiveness of control measures. A form of the natural attractant, obtained by crushing segments of the female, was formerly used, but its preparation was costly and time-consuming. Scientists have also synthesized a new attractant for the melon fly, called "Q-lure." It is vastly superior to other attractants that have been used and attracts immature as well as mature males. It thus permits detection of infestations before the pests can mate and build up to damaging proportions. If the new lure can be combined with poisons, the melon fly could conceivably be eradicated by male annihilation. The pest is not yet in the continental United States, but it is much feared because of its prodigious reproductive powers and destructiveness.

The development of a successful synthetic boll weevil diet should aid in the detection and control of this pest of cotton. The weevil can now be mass

reared in the laboratory and its habits studied--for example, how far it can, or is willing, to travel in order to hibernate and its hibernating habits, which may show where it is likely to turn up.

But while research is looking for additional weapons to aid in the detection of plant pests, awareness and alertness are still vital and must be considered the progenitors of most successful eradications. Participants in the intensified detection program are again urged to look for the following:

1. Unusual plant injury or failure in home plantings, crops, or forests.

2. Any unfamiliar type of destructive pest.

3. Sudden appearance of large numbers of damaging pests in crops, forests, or parks, or in stored products.

4. Evidence of unusual pest attacks on people, pets, or livestock.

AIDS TO FURTHER UNDERSTANDING

The United States Department of Agriculture publishes hundreds of informational aids to promote the understanding and appreciation of the plant pest problem. Recent additions are an educational motion picture, "Wanted--Plant Pest Detectives," and a program aid, "Detect and Report Your Insect Enemies." Both are available at regional Plant Pest Control Division offices. Special reports have been published on some of the pests discussed in this report. These are available from the Agricultural Research Service, U. S. Department of Agriculture, Washington 25, D. C.

ARS 22-15, The European Corn Borer

ARS 22-17, The Khapra Beetle

ARS 22-39, The Spotted Alfalfa Aphid

ARS 22-41, Witchweed

ARS 22-57, Hoja Blanca: Serious Threat to Rice Crops

Growth Through Agricultural Progress